(REV 11-98)

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

112740-315	25 SEP 2000
U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	09/937497

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/00635	01 March 2000	25 March 1999

TITLE OF INVENTION

METHOD OF CONTROLLING THE TRANSMITTING POWER IN A MOBILE RADIO SYSTEM AND CORRESPONDING MOBILE RADIO SYSTEM

APPLICANT(S) FOR DO/EO/US

Bernhard Raaf

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☒ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☒ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☒ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Return Receipt Postcard.

21. The following fees are submitted:.	CALCULATIONS PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :	
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1,000.00**	
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO **$860.00**	
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**	
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**	
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**	
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$860.00**
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$0.00**

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	32 - 20 =	12	x $18.00	**$216.00**
Independent claims	2 - 3 =	0	x $80.00	**$0.00**
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**
TOTAL OF ABOVE CALCULATIONS			=	**$1,076.00**
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable).**			☐	**$0.00**
SUBTOTAL			=	**$1,076.00**
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).			+	**$0.00**
TOTAL NATIONAL FEE			=	**$1,076.00**
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).**			☒	**$40.00**
TOTAL FEES ENCLOSED			=	**$1,116.00**
			Amount to be: refunded	$
			charged	$

☒ A check in the amount of **$1,116.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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SIGNATURE

Jeffrey H. Canfield, Esq.
NAME

38,404
REGISTRATION NUMBER

September 25, 2001
DATE

BOX PCT

IN THE UNITED STATES ELECTED/DESIGNATED OFFICE
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER THE PATENT COOPERATION TREATY-CHAPTER II

PRELIMINARY AMENDMENT

APPLICANT: Bernhard Raaf	DOCKET NO.: 112740-315
SERIAL NO.:	GROUP ART UNIT:
	EXAMINER:
INTERNATIONAL APPLICATION NO.:	PCT/DE00/00635
INTERNATIONAL FILING DATE:	01 March 2000

INVENTION: METHOD OF CONTROLLING THE TRANSMITTING POWER IN A MOBILE RADIO SYSTEM AND CORRESPONDING MOBILE RADIO SYSTEM

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Please amend the above-identified International Application before entry into the National stage before the U.S. Patent and Trademark Office under 35 U.S.C. §371 as follows:

In the Specification:

Please replace the Specification of the present application, including the Abstract, with the following Substitute Specification:

SPECIFICATION

TITLE

"METHOD OF CONTROLLING THE TRANSMITTING POWER IN A MOBILE RADIO SYSTEM AND CORRESPONDING MOBILE RADIO SYSTEM"

BACKGROUND OF THE INVENTION

The present invention relates to a method of controlling the transmitting power in a mobile radio system and to a corresponding mobile radio system.

Controlling the transmitting power represents an important feature in mobile radio systems in order to prevent possible interference between individual connections. Preventing interference between connections improves the capacity and quality of the connections and allows the mean transmitting power to be reduced. Thus, the transmission power may be ideally adapted to the transmission requirements, and losses through the transmission channels may be at least partially compensated for.

For the purpose of controlling the transmitting power in a mobile radio system, the signal transmitted by a transmitter is evaluated at the receiver. Power control information is generated based on the power of the received signal and is transmitted back to the transmitter. The transmitter may then adjust the transmitting power as necessary in accordance with the received power control information. The received level and/or the received quality of the transmitted signal can be measured by the receiver and values associated with the received level and/or quality may be transmitted to the transmitter. The transmitter correspondingly corrects the transmitting power in dependence on the received values. This approach is used, for example, in Global System for Mobile Communications (GMB) mobile radio systems. Alternatively, the receiver itself can be adapted to generate nominal values or adjustment commands for adjusting the transmitting power in dependence on the measured level of the received transmit signal. The receiver may then transmit these nominal values or adjustment commands to the transmitter which then adjusts the transmitting power accordingly. This approach is used, for example, in Code Division Multiple Access (CDMA) mobile radio systems and, in particular, is provided in accordance with the current state of Universal Mobile Telecommunication System (UMTS) standardization for UMTS mobile radio systems which are to be operated in accordance with a Wideband Code Division Multiple Access (WCDMA) method. In each approach, the power of the transmitter is always controlled in a manner that takes into consideration the current properties of the transmission channel. In each case, the power needed for satisfactory transmission arrives at the receiver as accurately as possible in spite of fading effects.

However, employing this method, the transmitter can only react to the measurements of the receiver. The inherent delay in waiting for the power information feedback signal from the receiver leads to a degradation of the transmission characteristic of the mobile radio system. This is especially true at higher speeds of the receiver.

One proposal for solving this problem for CDMA mobile radio systems has been to reduce the response time or delay in the power control signal to as short a time as possible. This can be achieved by employing a high frequency a power control signal, having a frequency that is as high as possible within the mobile radio system, and clever interleaving of the timeslots of the uplink and downlink connections. In furtherance of this proposed solution, it has been proposed to shift the frame structure of the uplink connection (the connection from the mobile station to the base station) by 250 μs with respect to the frame structure of the downlink connection (the connection from the base station to the mobile station) in order to provide for transmission of the transmitting power control information signal with a time delay of only one timeslot if the symbol transmission rate of the downlink connection is higher than 16 ksps. This proposal is described, for example, in ARIB, Volume 3, Specification of Air Interface for 3G Mobile System, Version 0.5, Section 3.2.2.1.

However, the procedure described above places a premium on the accurate measurement of the channel impulse response of the corresponding transmission channel. This is essential for assessing the behavior and state of the transmission channel since signal distortion can occur due to certain operating conditions. Such signal distortion renders information transmission impossible in the most extreme cases. Therefore, in mobile radio systems the current channel impulse response is measured in the receiver so that if signal distortion is found, the distortion may be subsequently corrected if necessary, using corresponding equalizers.

SUMMARY OF THE INVENTION

The present invention provides a method for locating a vehicle as well as a system for doing the same. According to the method of the invention, position data are determined by a positioning device at the vehicle. Once the position data are determined, they are transferred to a mobile radio terminal, where they may be displayed in a variety of different formats.

In light of the preceding background, an object of the present invention is to create an improved method of controlling the transmitting power in a mobile radio system. The present invention further provides a corresponding mobile radio system which eliminates the influence of delays in the power control system as completely as possible.

According to an embodiment of the invention, a method for controlling the transmitting power in a mobile radio system is provided. According to the power control system of the mobile radio system, a signal transmitted by a transmitter is received by a

receiver via a transmission channel of the mobile radio system. The signal received by the receiver is evaluated and a power control information item is generated in dependence on the evaluation of the received signal. The power control information item is then transmitted to the transmitter. The power of the signal transmitted by the transmitter is then adjusted based on the result of the estimation of the behavior of the transmission channel. Finally, a step is performed in which a power control information item is generated based on the estimated necessary transmission power, and is transmitted to the transmitter.

Thus, according to the invention, the behavior of the transmission channel is estimated and the necessary transmitting power is estimated based on the estimated channel behavior. The power control information to be transmitted to the transmitter can then be generated on the basis of the estimated necessary transmitting power.

The step of estimating the behavior of the transmission channel involves estimating the behavior of the channel over time, as well as predicting a future state of the transmission channel. Thus, the transmitting power needed in the future can be calculated based on the estimated behavior and state of the transmission channel. In contrast to the known state of the art, the power control information which represents the basis for adjusting the transmitting power of the transmitter is not based on the instantaneous measured value of the received level or of the received quality of the transmit signal but on the above-described prediction of the channel state and the transmitting power needed in future. In this manner, the influence of delays can be eliminated in the control of the transmitting power if the behavior of the transmission channel can be predicted with sufficient accuracy. The behavior of the channel state can be estimated, for example, via the channel impulse response.

The method of determining power control information of the present invention can be combined with other methods for determining power control information and the proportion of the power control information determined according to the method of the present invention to be transmitted to the transmitter may be reduced or completely eliminated with increasing speed of the receiver or, respectively, the mobile station, since accurate estimates become ever more difficult with increasing speeds.

In addition to a method for controlling transmitting power in a mobile radio system, the present invention further provides a mobile radio system having a transmitting power control feature. The mobile radio system includes a transmitter and a receiver. The receiver receives a signal from the transmitter via a transmission channel of the mobile radio system.

The receiver is adapted to evaluate the received signal and generate a power control information item in dependence thereon. The receiver if further adapted to transmit the power control information item to the transmitter. The transmitter, in turn, is constructed in a manner such that it adjusts the transmitting power of the transmitted signal in dependence on the power control information received from the receiver. The receiver generates the power control information item by first estimating the behavior of the transmission channel based on the received signal transmitted from the transmitter, and determines the necessary transmitting power based on the result of the estimated behavior of the transmission channel. The receiver further generates and transmits the power control information item to the transmitter.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 is a diagram explaining the principle forming the basis of the present invention;

Fig. 2 is a diagram of a mobile radio system; and

Fig. 3 is a representation of the frame and timeslot pattern for a so-called downlink connection according to the current state of UMTS standardization.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 2 shows the communication links between a base station 1 and a mobile radio station 2 of a mobile radio system. A connection from the base station 1 to the mobile part 2 is called the downlink or forward link connection and a connection from the mobile part 2 to the base station 1 is called the uplink or reverse link connection. To control the power of the downlink, the respective received signal is evaluated in the mobile station 2 and, depending on the result of the evaluation, a power control information item is generated by the mobile station 2 and sent back to the base station 1 so that the base station 1 can correspondingly adjust the transmitting power of the downlink. To control the uplink, the received signal is evaluated in the base station 1, where the power control information is generated and the mobile station 2 is instructed for power matching.

The power information item is transmitted in dependence on the respective mobile radio system linking with a predetermined frame structure.

Figure 3 shows the frame and timeslot structure for a downlink connection via a UMTS mobile radio channel, also called DPCH (Dedicated Physical Channel). The present invention is preferably applied to corresponding UMTS mobile radio systems. The frame structure with a period of 720 ms includes, in particular, 72 identically structured frames 3

having with a frame period of 10 ms. Each frame, in turn, includes 16 timeslots 4. Each timeslot has a period of 0.625 ms. Each timeslot 4 comprises bit information which is divided into a logical control channel known as a Dedicated Physical Control Channel (DPCC) and a logical data channel Dedicated Physical Data Channel (DPDC). The bits of the DPCCH section form a pilot bit sequence 5 and so called Transmitter Power Control (TPC) controlled bits 6 and Transmitter Format Identifier (TFI) control bits 7. The DPDCH section forms the user data bits 8. The structure shown in figure 3 can be found, for example, in the document ETSI STC SMG2 UMTS – L1: Tdoc SMG2 UMTS-L1 221/98.

The pilot bit sequence 5 is used for estimating the channel impulse response during a so called training sequence, as already mentioned above, and corresponds to a known bit pattern. If the pilot bit sequence is called s(t), the channel impulse response h(t) and the received signal or, respectively, the training sequence is called r(t), the following relationship holds true:

$$r(t) = s(t) * h(t).$$

The receiver can thus determine or estimate the channel impulse response h(t) of the mobile radio channel by comparing the received signal r(t) with the known pilot bit sequence s(t). The signal-matched filters, for example, may be used for this purpose to calculate the channel impulse response h(t) by calculating the correlation between the received signal r(t) and the pilot bit sequence s(t).

The TPC bits 6 comprise the power control information. In UMTS mobile radio systems the received signal is evaluated and compared with predetermined quality requirements or reference values in the receiver. Depending on this comparison, the receiver generates a control command and transmits the control command to the transmitter via the TPC bit field in order to instruct the transmitter to correspondingly adapt the transmitting power.

In the text which follows, the principle forming the basis of the present invention is explained with reference to Fig. 1.

The time response or state of the transmission channel is predicted in order to be able to estimate the transmitting power needed in future based on the predicted future state of the transmission channel. The behavior of the transmission channel can be assessed via the channel impulse response.

In the representation shown in Fig. 1 it will be assumed that, at the moment, the transmitting power for timeslot n is to be determined in order to be able to transmit a corresponding power control command to the transmitter. The values of the channel impulse responses, measured by means of the pilot bit sequences 5 transmitted in the respective timeslots for timeslots n-2 and n-1, and the values P_{n-2} and P_{n-1}, respectively, for the transmitting power determined for these timeslots are known in the receiver such that the receiver can extrapolate the future channel state or the transmitting power P_n needed for timeslot n in the future on the basis of these known values. This extrapolation is indicated by a dashed line in Fig. 1. The extrapolated power value P_n forms the basis for the receiver controlling the transmitting power, by forming the basis for the power control information 6 which the receiver transmits to the transmitter.

Thus, variation of the fast fading may predicted as far as possible, assuming, as a rule, Rayleigh fading. When so called rake receivers are used, the prediction is performed for every rake finger. In rake receivers, the received signal is processed in a number of paths, the so called rake fingers. Each of these rake fingers is adjusted with optimized phase angle to a multi-path signal in order to achieve an increasing gain with the presence of multipath signals which arrive at the receiving antenna with different propagation delay. Deep fading dips occur whenever the channel impulse response exhibits an (approximate) zero transmission for all or at least the dominant paths. This circumstance can be reliably predicted if both the intervals of the estimation of the channel impulse response and the period of prediction are selected to be shorter than the so called coherence time of the transmission channel, in order to provide for reasonable data detection. The period of prediction is shorter than the coherence time of the transmission channel at least at low to medium speeds of the mobile station 2.

As shown in Fig. 1, the previously measured channel impulse response can be linearly extrapolated for predicting the transmitting power needed in future. Naturally, however, other approaches are also conceivable.

When the mobile station 2 is moving at high speeds, it can be difficult to accurately and reliably predict the future behavior of the transmission channel and the transmitting power needed in future. For this reason, an aspect of the present invention is to combine the principle of estimating the behavior of the transmitting channel and predicting the necessary transmission power according to the invention with other power control principles. The

power control information can be determined according to these combined principles and the proportion of the prediction that can be ascribed to the principles that form the basis of the present invention for determining the power control information that is sent from the receiver to the transmitter can be reduced or completely eliminated based on the characteristic behavior of the transmission channel, such as when the mobile station 2 is traveling at higher speeds.

By combining power control principals, the method according to the present invention can be used only when the mobile station 2 is traveling in a particular speed range which is not too high, while at other times the power control information 6 may be conventionally determined by means of the instantaneously measured level of the received signal since the conventional non-predictive power control method is quite adequate for satisfactory control of the transmitting power, for example at low speeds of the mobile station 2.

However, it is particularly advantageous if the switching between the power control method of the present invention and alternative methods for determining the power control information is not "hard" but "soft" or gradual. Thus, the nominal value used for the transmitting power in a certain speed range can be, for example, a value which is composed of 70% of the current measured value of the received power and 30% of the value predicted according to the invention. In other words, the nominal value for the transmitting power may be based on a weighting of various values which have been determined in different ways, one of these values having been determined according to the invention. In this case, it can be said that the received power and the nominal transmitting power derived therefrom are not calculated in advance by one timeslot 4 but by a fraction a of a timeslot, a representing a correction factor and reflecting the reliability of the prediction. The correction factor a can have values between 0 and 1 and is 0.3 in the example described above.

In the above description, it has been assumed that the behavior or the state of the transmission channel is predicted by estimating the channel impulse response. Alternatively, it is also possible to predict the so called carrier/interferer ratio C/I in order to derive the transmitting power needed in future therefrom. Similarly, it is also possible to predict only the component C (corresponding to the carrier signal) or the component I (corresponding to the interference) in order to estimate the transmitting power needed in future.

CLAIMS

1. A method for controlling the transmitting power in a mobile radio system, in which a signal is transmitted from a transmitter via a transmission channel of the mobile radio system and received by a receiver, the method comprising the steps of:

evaluating the signal received by the receiver

generating a power control information item based on the evaluation of the received signal;

transmitting the power control information item to the transmitter;

adjusting the transmitting power at the transmitter in dependence on the power control information item;

estimating the behavior of the transmission channel;

estimating the transmitting power needed based on the result of the estimation of the behavior of the transmission channel;

wherein the power control information item is generated on the basis of the estimated transmitting power needed and is transmitted to the transmitter; and

the estimated behavior of the transmission channel is determined by prediction and the transmitting power needed in future is estimated in dependence on the result of the prediction of the behavior of the transmission channel.

2. The method as claimed in claim 1, wherein the behavior of the transmission channel state is estimated by predicting the channel impulse response.

3. The method as claimed in claim 1, wherein the behavior of the transmission channel state is estimated by predicting the carrier/interferer ratio.

4. The method as claimed in one of claim 3, wherein the behavior of the transmission channel is estimated at regular intervals, the interval between the individual estimates of the behavior of the transmission channel and the period over which the behavior of the

transmission channel is predicted being selected to be shorter than a coherence time of the transmission channel.

5. The method as claimed in claim 4 wherein the value of the power control information item (6) is adjusted to be linearly dependent on the result of the estimation of the behavior of the transmission channel.

6. The method as claimed in claim 5 wherein the power control information item is generated in dependence on the estimated behavior of the transmission channel and also additionally in dependence on the instantaneously measured received level of the signal received by the receiver, the proportion of the estimated behavior of the transmission channel in the generation of the power control information item being adjusted in dependence on the characteristic behavior of the transmission channel.

7. The method as claimed in claim 6, wherein one of the transmitter and receiver is a mobile unit, and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information is reduced at higher speeds of the mobile unit.

8. The method as claimed in claim 7, further comprising the step of estimating the instantaneous speed of the mobile unit and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information item is adjusted in dependence on the estimated speed of the mobile unit.

9. The method as claimed in claim 8, further comprising the step of measuring the channel impulse response of the transmission channel, and estimating the coherence time of the transmission channel in dependence on the measured channel impulse response in order to derive the instantaneous speed of the mobile unit therefrom.

10. The method as claimed in one of claim 2, wherein the behavior of the transmission channel is estimated at regular intervals, the interval between the individual estimates of the behavior of the transmission channel and the period over which the behavior of the transmission channel is predicted being selected to be shorter than a coherence time of the transmission channel.

11. The method as claimed in claim 10 wherein the value of the power control information item (6) is adjusted to be linearly dependent on the result of the estimation of the behavior of the transmission channel.

12. The method as claimed in one of claim 1, wherein the behavior of the transmission channel is estimated at regular intervals, the interval between the individual estimates of the behavior of the transmission channel and the period over which the behavior of the transmission channel is predicted being selected to be shorter than a coherence time of the transmission channel.

13. The method as claimed in claim 12 wherein the value of the power control information item (6) is adjusted to be linearly dependent on the result of the estimation of the behavior of the transmission channel.

14. The method as claimed in claim 3 wherein the power control information item is generated in dependence on the estimated behavior of the transmission channel and also additionally in dependence on the instantaneously measured received level of the signal received by the receiver, the proportion of the estimated behavior of the transmission channel in the generation of the power control information item being adjusted in dependence on the characteristic behavior of the transmission channel.

15. The method as claimed in claim 14, wherein one of the transmitter and receiver is a mobile unit, and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information is reduced at higher speeds of the mobile unit.

16. The method as claimed in claim 15, further comprising the step of estimating the instantaneous speed of the mobile unit and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information item is adjusted in dependence on the estimated speed of the mobile unit.

17. The method as claimed in claim 16, further comprising the step of measuring the channel impulse response of the transmission channel, and estimating the coherence time of the transmission channel in dependence on the measured channel impulse response in order to derive the instantaneous speed of the mobile unit therefrom.

18. The method as claimed in claim 3 wherein the power control information item is generated in dependence on the estimated behavior of the transmission channel and also additionally in dependence on the instantaneously measured received level of the signal received by the receiver, the proportion of the estimated behavior of the transmission channel in the generation of the power control information item being adjusted in dependence on the characteristic behavior of the transmission channel.

19. The method as claimed in claim 18, wherein one of the transmitter and receiver is a mobile unit, and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information is reduced at higher speeds of the mobile unit.

20. The method as claimed in claim 19, further comprising the step of estimating the instantaneous speed of the mobile unit and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information item is adjusted in dependence on the estimated speed of the mobile unit.

21. The method as claimed in claim 20, further comprising the step of measuring the channel impulse response of the transmission channel, and estimating the coherence time of the transmission channel in dependence on the measured channel impulse response in order to derive the instantaneous speed of the mobile unit therefrom.

22. The method as claimed in claim 2 wherein the power control information item is generated in dependence on the estimated behavior of the transmission channel and also

additionally in dependence on the instantaneously measured received level of the signal received by the receiver, the proportion of the estimated behavior of the transmission channel in the generation of the power control information item being adjusted in dependence on the characteristic behavior of the transmission channel.

23. The method as claimed in claim 22, wherein one of the transmitter and receiver is a mobile unit, and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information is reduced at higher speeds of the mobile unit.

24. The method as claimed in claim 23, further comprising the step of estimating the instantaneous speed of the mobile unit and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information item is adjusted in dependence on the estimated speed of the mobile unit.

25. The method as claimed in claim 24, further comprising the step of measuring the channel impulse response of the transmission channel, and estimating the coherence time of the transmission channel in dependence on the measured channel impulse response in order to derive the instantaneous speed of the mobile unit therefrom.

26. The method as claimed in claim 1 wherein the power control information item is generated in dependence on the estimated behavior of the transmission channel and also additionally in dependence on the instantaneously measured received level of the signal received by the receiver, the proportion of the estimated behavior of the transmission channel

in the generation of the power control information item being adjusted in dependence on the characteristic behavior of the transmission channel.

27. The method as claimed in claim 26, wherein one of the transmitter and receiver is a mobile unit, and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information is reduced at higher speeds of the mobile unit.

28. The method as claimed in claim 27, further comprising the step of estimating the instantaneous speed of the mobile unit and wherein the proportion of the estimated behavior of the transmission channel in the generation of the power control information item is adjusted in dependence on the estimated speed of the mobile unit.

29. The method as claimed in claim 28, further comprising the step of measuring the channel impulse response of the transmission channel, and estimating the coherence time of the transmission channel in dependence on the measured channel impulse response in order to derive the instantaneous speed of the mobile unit therefrom.

30. A mobile radio system comprising;

a transmitter;

a receiver for receiving a signal of the transmitter transmitted via a transmission channel of the mobile radio system and for evaluating the received signal in order to generate a power control information item in dependence thereon, and to transmit the power control information item to the transmitter;

the transmitter being constructed in a manner such that the transmitting power is adjusted in dependence on the power control information of the receiver;

the receiver being constructed in a manner such that the behavior of the transmission channel is estimated in dependence on the received signal, and the receiver determines the needed transmitting power based on the result of the estimation of the behavior of the transmission channel, and wherein the receiver generates the power control information item and transmits the power control information item to the transmitter on the basis of the determined necessary transmitting power.

31. The mobile radio system as claimed in claim 30, wherein the receiver generates the power control information item in the form of a command for adjusting the transmitting power directed to the transmitter.

32. The mobile radio system as claimed in claim 31, characterized in that the mobile radio system is a CDMA mobile radio system.

ABSTRACT OF THE DISCLOSURE

A method is provided for controlling the transmitting power in a mobile radio system a corresponding mobile radio system is also provided. A signal emitted from a transmitter is received by a receiver via a transmission channel of the mobile radio system. The transmitted signal is evaluated and a power control information item is generated based on the result of the evaluation. The power control information item is then transmitted back to the transmitter for adjusting the transmitting power. In order to determine the power control information item, the time response of the transmission channel is estimated and the transmitting power needed in the future is deduced therefrom.

REMARKS

The present amendment make editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States Patent Practice.

Early consideration on the merits is respectfully requested

Respectfully submitted,

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BOX PCT

IN THE UNITED STATES ELECTED/DESIGNATED OFFICE
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER THE PATENT COOPERATION TREATY-CHAPTER II

SUBMISSION OF DRAWINGS

APPLICANT:	Bernhard Raaf	DOCKET NO.:	112740-315
SERIAL NO:		GROUP ART UNIT:	
FILED:		EXAMINER:	
INTERNATIONAL APPLICATION NO.		PCT/DE00/00635	
INTERNATIONAL FILING DATE:		01 March 2000	
INVENTION:	METHOD OF CONTROLLING THE TRANSMITTING POWER IN A MOBILE RADIO TELEPHONE SYSTEM AND CORRESPONDING MOBILE RADIO SYSTEM		

Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

Applicant herewith submits two sheets (Figs. 1-3) of drawings for the above-referenced PCT application.

Respectfully submitted,

(Reg. No. 38,404)

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FIG 1

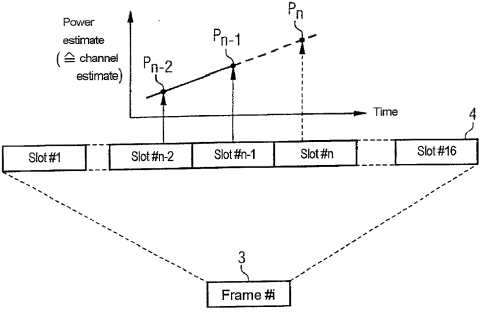


FIG 2

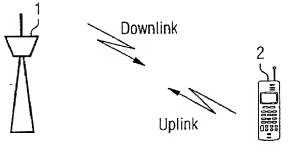
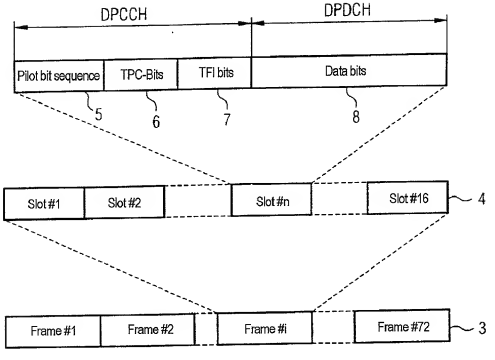


FIG 3


DPCCH
DPDCH
Pilot bit sequence
TPC-Bits
TFI bits
Data bits
5
6
7
8
Slot #1
Slot #2
Slot #n
Slot #16
4
Frame #1
Frame #2
Frame #i
Frame #72
3

Description

Method of controlling the transmitting power in a mobile radio system and corresponding mobile radio system

The present invention relates to a method of controlling the transmitting power in a mobile radio system and to a corresponding mobile radio system.

In mobile radio systems, controlling the transmitting power represents an important feature in order to be able to stop possible interference between the individual connections and thus improve the capacity and quality of the connections and in order to be able to reduce the mean transmitting power and to adapt it to the requirements in the best possible way and compensate at least partially for losses through the transmission channels.

For this purpose, the signal transmitted by a transmitter is evaluated at the receiving end in the mobile radio system in order to be able to generate in dependence thereon information for the power control and transmit it to the transmitter which thereupon adjusts the transmitting power in accordance with the power control information.

In this process, the received level and/or the received quality of the transmit signal can be measured by the receiver and transmitted as actual values to the transmitter which correspondingly corrects the transmitting power in dependence on these actual values. This approach is used, for example, in the GSM (Global System for Mobile Communications) mobile radio systems. As an alternative, the receiver itself can also generate nominal values or, respectively, adjustment commands for the transmitting power in

dependence on the measured received level of the transmit signal and transmit these to the transmitter which thereupon correspondingly adjusts the transmitting power. This approach is used, for example, in CDMA (Code Division Multiple Access) mobile radio systems and, in particular, is provided in accordance with the current

state of UMTS (Universal Mobile Telecommunication System) standardization for UMTS mobile radio systems which are to be operated in accordance with a WCDMA (Wideband Code Division Multiple Access) method. In each approach, the power of the transmitter is always controlled in such a manner that, taking into consideration the current properties of the transmission channel, the power needed in each case arrives as accurately as possible at the receiver in spite of fading effects.

However, the transmitter can only react to the measurements of the receiver and the power information subsequently supplied to it with a certain delay which leads to a degradation of the transmission characteristic of the mobile radio system especially at higher speeds of the receiver.

To solve this problem, it has been proposed for CDMA mobile radio systems to achieve as short a response time or delay in the power control as possible by means of as high a power control frequency as possible and clever interleaving of the timeslots of the uplink and downlink connections. In particular, it has been provided in accordance with this proposal to shift the frame structure of the uplink connection, i.e. the connection between the mobile station and the base station, by 250 µs with respect to the frame structure of the downlink connection, i.e. the connection between the base station and the mobile station in order to provide for power control of the transmitting power with a time delay of only one timeslot if the symbol transmission rate of the downlink connection is higher than 16 ksps. This proposal is described, for example, in ARIB, Volume 3, Specification of Air Interface for 3G Mobile System, Version 0.5, Section 3.2.2.1.

However, the procedure described above places the burden on an accurate measurement of the channel impulse response of the

corresponding transmission channel which, however, is essential for assessing the behavior and the state of the transmission channel since, due to certain operating conditions, signal distortion can occur which renders information transmission impossible in the most extreme case. In mobile radio systems, therefore, the current channel impulse response is measured in the receiver in order to be able to subsequently correct, if necessary, signal distortion found, using corresponding equalizers.

For this reason, the present invention is based on the object of creating an improved method of controlling the transmitting power in a mobile radio system and a corresponding mobile radio system by means of which the influence of delays in the power control can be eliminated as completely as possible.

According to the invention, this object is achieved by a method having the features of claim 1 and, respectively, a corresponding radio mobile system having the features of claim 11. The subclaims in each case describe preferred and advantageous embodiments of the present invention.

According to the invention, it is proposed to estimate the behavior of the transmission channel and, depending on this the transmitting power needed so that the power control information to be transmitted to the transmitter can be generated on the basis of the estimated transmitting power needed.

In particular, the behavior with time or the state of the respective transmission channel is predicted so that the transmitting power needed in future can be estimated in dependence thereon. In contrast to the known state of the art, the power control information

which represents the basis for the adjustment of the transmitting power at the transmitting end is not based on the instantaneous measured value

of the received level or of the received quality of the transmit signal but on the above-described prediction of the channel state and the transmitting power needed in future. In this manner, the influence of delays can be eliminated in the power control of the transmitting power if the behavior of the transmission channel can be predicted with sufficient accuracy.

The behavior of the channel state can be estimated, for example, via the channel impulse response.

The invention can be combined with other methods for determining the power control information and the proportion of the method of the present invention in the determination of the power control information to be transmitted to the transmitter is reduced or completely eliminated with increasing speed of the receiver or, respectively, the mobile station since accurate estimates become ever more difficult with increasing speeds.

In the text which follows, the invention is explained in greater detail, referring to the attached drawing, in which:

fig. 1 shows a diagrammatic representation for explaining the principle forming the basis of the present invention,

fig. 2 shows a diagrammatic representation of a mobile radio system for explaining the information transmission in the power control, and

fig. 3 shows the frame and timeslot pattern for a so-called downlink connection according to the current state of UMTS standardization.

Figure 2 shows the communication between a base station 1 and a mobile radio station 2 of a mobile radio system. A connection from the base station 1 to the mobile part 2 is

called downlink or forward link connection whereas a connection from the mobile part 2 to the base station 1 is called uplink or reverse link connection. To control the power of the downlink, the respective received signal is evaluated in the mobile station 2 and, depending on this, a power control information item is generated and sent back to the base station 1 so that the base station 1 can correspondingly adjust the transmitting power. To control the uplink, the received signal is evaluated in the base station 1, where the power control information is generated and the mobile station 2 is instructed for power matching.

The power information item is transmitted in dependence on the respective mobile radio system linking with a predetermined frame structure.

Figure 3 shows the frame and timeslot structure for a downlink connection via a UMTS mobile radio channel, also called DPCH (Dedicated Physical Channel), the present invention being applied preferably to corresponding UMTS mobile radio systems. The frame structure with a period of 720 ms comprises, in particular, 72 identically structured frames 3 with a frame period of 10 ms, each frame, in turn, having in each case 16 timeslots 4 with a timeslot period of 0.625 ms. Each timeslot 4 comprises bit information which is divided into a logical control channel (DPCCH - Dedicated Physical Control Channel) and a logical data channel (DPDCH - Dedicated Physical Data Channel). The bits of the DPCCH section comprise a pilot bit sequence 5 and so called TPC (Transmitter Power Control) controlled bits 6 and TFI (Transmitter Format Identifier) control bits 7. The DPDCH section comprises user data bits 8. The structure shown in figure 3 can be found, for example, in the document ETSI STC SMG2 UMTS - L1: Tdoc SMG2 UMTS-L1 221/98.

The pilot bit sequence 5 is used for estimating the channel impulse response during a so called training sequence, as already mentioned above, and corresponds to a known bit pattern. If the pilot bit sequence is called s(t), the channel impulse response h(t) and the received signal or, respectively, the training sequence is called r(t), the following holds true:

$$r(t) = s(t) * h(t).$$

The receiver can thus determine or estimate the channel impulse response h(t) of the mobile radio channel by comparing the received signal r(t) with the known pilot bit sequence s(t), the signal-matched filters, for example, being used for this purpose which calculate the channel impulse response h(t) by calculating the correlation between the received signal r(t) and the pilot bit sequence s(t).

The TPC bits 6 comprise the power control information, and in UMTS mobile radio systems the received signal is evaluated and compared with predetermined quality requirements or reference values in the receiver. Depending on this comparison, the receiver generates a control command and transmits it in the form of the TPC bit field 6 to the transmitter in order to instruct the latter to correspondingly adapt the transmitting power.

In the text which follows, the principle forming the basis of the present invention is explained with reference to figure 1.

The time response or state of the transmission channel is predicted in order to be able to estimate, in dependence thereon, the transmitting power needed in future. The behavior of the transmission channel can be assessed, in particular, via the channel impulse response.

In the representation of figure 1 it will be assumed that, at the moment, the transmitting power for timeslot n is to be determined in order to be able to transmit a corresponding power control command to the transmitter. The values of the channel impulse responses, measured by means of the pilot bit sequences 5 transmitted in the respective timeslots for timeslots n-2 and n-1, and the values P_{n-2} and P_{n-1}, respectively, for the transmitting power determined for these timeslots are known in the receiver such that the receiver can extrapolate the future channel state or the transmitting power P_n needed for timeslot n in future on the basis of these known values which is indicated by a dashed line in figure 1. This extrapolated power value P_n is then used by the receiver for controlling the transmitting power, i.e. used as a basis for the power control information 6 to be transmitted to the transmitter.

Thus, the variation of the fast fading is predicted as far as possible, assuming, as a rule, Rayleigh fading. When so called rake receivers are used, the prediction is performed for every rake finger. In rake receivers, the received signal is processed in a number of paths, the so called rake fingers. Each of these rake fingers is adjusted with optimized phase angle to a multi-path signal in order to achieve an increasing gain with the presence of multipath signals which arrive at the receiving antenna with different propagation delay. Deep fading dips occur whenever the channel impulse response exhibits an (approximate) zero transmission for all or at least the dominant paths. This circumstance can be reliably predicted if both the intervals of the estimation of the channel impulse response and the period of prediction are selected to be shorter than the so called coherence time of the transmission channel, in order to provide for reasonable data detection. The period of prediction

is shorter than the coherence time of the transmission channel at least at low to medium speeds of the mobile station 2.

As shown in figure 1, the channel impulse response measured for the past can be linearly extrapolated for predicting the transmitting power needed in future. Naturally, however, other approaches are also conceivable.

At high speeds of the mobile station 2, an accurate and reliable prediction of the future behavior of the transmission channel and of the transmitting power needed in future, respectively, can be difficult. For this reason, it is provided in accordance with an exemplary embodiment of the invention, in determining the power control information 6, to combine the principle according to the invention with other principles with the aid of which the power control information can be determined, where the proportion of the prediction according to the invention of the determination of the power control information can be reduced or completely eliminated in dependence on the characteristic behavior of the transmission channel, e.g. at higher speeds of the mobile station 2.

Thus, for example, the method according to the invention can only be used in a particular speed range of the mobile station 2 which is not too high whilst otherwise the power control information 6 is conventionally determined by means of the instantaneously measured level of the received signal since the conventional non-predictive power control method is quite adequate for satisfactory control of the transmitting power, for example at low speeds of the mobile station 2.

However, it is particularly advantageous if the switching between the invention and the further method for determining

the power control information is not "hard" but "soft". Thus, the nominal value used for the transmitting power in a certain speed range can be, for example, a value which is composed of 70% of the current measured value of the received power and of 30% of the value predicted according to the invention, i.e. the nominal value for the transmitting power is based on a weighting of various values which have been determined in different ways, one of these values having been determined according to the invention. In this case, it can be said that the received power and the nominal transmitting power derived therefrom are not calculated in advance by one timeslot 4 but by a fraction a of a timeslot, a representing a correction factor and reflecting the reliability of the prediction. The correction factor a can have values between 0 and 1 and is 0.3 in the example described above.

In the above description, it has been assumed that the behavior or the state of the transmission channel is predicted by estimating the channel impulse response. However, it is also possible to predict instead the so called carrier/interferer ratio C/I in order to derive therefrom the transmitting power needed in future. Similarly, it is also possible to predict only the component C (corresponding to the carrier signal) or the component I (corresponding to the interference) in order to estimate the transmitting power needed in future.

Patent claims

1. A method for controlling the transmitting power in a mobile radio system, in which a signal of a transmitter (1), received by a receiver (2) via a transmission channel of the mobile radio system, is evaluated and in dependence thereon a power control information item (6) is generated and transmitted to the transmitter (1), and
in which the transmitting power is adjusted in dependence on the power control information item (6) in the transmitter (1),
in which the behavior of the transmission channel is estimated,
in which the transmitting power needed is estimated in dependence on the result of the estimation of the behavior of the transmission channel,
in that the power control information item (6) is generated on the basis of the estimated transmitting power needed and is transmitted to the transmitter (1),
characterized in that
the behavior of the transmission channel is estimated by prediction and in that the transmitting power needed in future is estimated in dependence on the result of the prediction of the behavior of the transmission channel.

2. The method as claimed in claim 1, characterized in that the behavior of the channel state is estimated by predicting the channel impulse response.

3. The method as claimed in claim 1, characterized in that the behavior of the channel state is estimated by predicting the carrier/interferer ratio.

4. The method as claimed in one of claims 1 to 3, characterized in that the behavior of the transmission channel is estimated regularly, the interval between the individual estimates and the period over which the behavior of the transmission channel is predicted being in each case selected to be shorter than the coherence time of the transmission channel.

5. The method as claimed in one of the preceding claims, characterized in that the value of the power control information item (6) is adjusted to be linearly dependent on the result of the estimation of the behavior of the transmission channel.

6. The method as claimed in one of the preceding claims, characterized in that the power control information item (6) is generated in dependence on the estimated behavior of the transmission channel and additionally in dependence on the instantaneously measured received level of the signal received by the receiver (2), the proportion of the estimated behavior of the transmission channel in the generation of the power control information item (6) being adapted in dependence on the characteristic behavior of the transmission channel.

7. The method as claimed in claim 6, characterized in that the transmitter (1) or receiver (2) is a mobile unit and in that the proportion of the estimated behavior of the transmission channel in the generation of the power control information (6) is reduced at higher speeds of the mobile unit.

8. The method as claimed in claim 7, characterized in that the instantaneous speed of the mobile unit is estimated and in that the proportion of the estimated behavior of the transmission channel in the generation of the power control information item (6) is adjusted in dependence on the estimated speed of the mobile unit.

9. The method as claimed in claim 8, characterized in that the channel impulse response of the transmission channel is measured and in dependence thereon the coherence time of the transmission channel is estimated in order to derive therefrom the instantaneous speed of the mobile unit.

10. A mobile radio system comprising a transmitter (1) and a receiver (2) for receiving a signal of the transmitter (1) transmitted via a transmission channel of the mobile radio system and for evaluating the received signal in order to generate in dependence thereon, and to transmit to the transmitter (1), a power control information item (6), the transmitter (1) being constructed in such a manner that it adjusts the transmitting power in dependence on the power control information of the receiver (2), in which the receiver (2) is constructed in such a manner that it estimates the behavior of the transmission channel in dependence on the received signal, determines the transmitting power needed in dependence on the result of the estimation of the behavior of the transmission channel and generates, and transmits to the transmitter (1), the power control information item (6) on the

basis of the necessary transmitting power determined,
characterized in that the receiver (2) is constructed for performing the method as claimed in one of claims 1-9.

11. The mobile radio system as claimed in claim 10, characterized in that the receiver (2) generates the power control information item (6) in the form of a command for adjusting the transmitting power directed to the transmitter (1).

12. The mobile radio system as claimed in claim 11, characterized in that the mobile radio system is a CDMA mobile radio system.

FIG 1

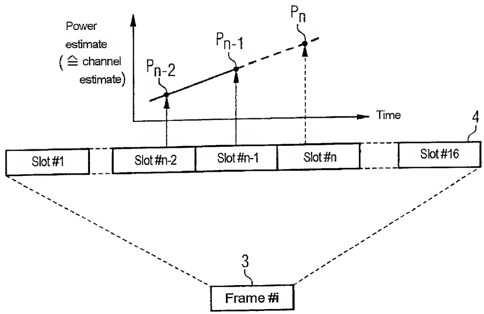

Power
estimate
(≙ channel
estimate)
P_{n-2}
P_{n-1}
P_n
Time
4
Slot #1
Slot #n-2
Slot #n-1
Slot #n
Slot #16
3
Frame #i

FIG 2

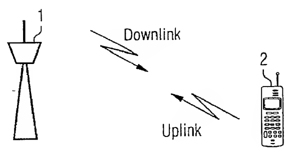
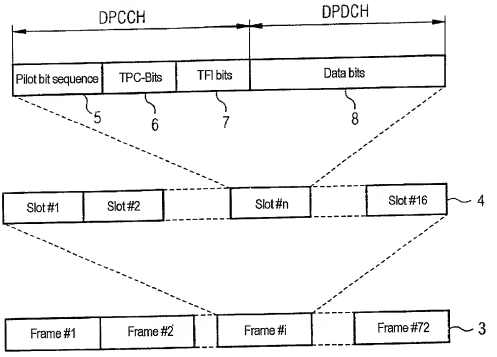

1
Downlink
2
Uplink

FIG 3



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I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren zur Regelung der Sendeleistung in einem Mobilfunksystem und entsprechendes Mobilfunksystem

Method of controlling the transmitting power of a mobile radio telephone system and corresponding mobile radio system

deren Beschreibung

the specification of which

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☒ am 01.03.2000 als
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PCT Anmeldungsnummer PCT/DE00/00635
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I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign appplications
Priorität beansprucht

			Priority Claimed	
19913629.7	DE	25.03.1999	☒	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein
			☐	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein
			☐	☐
(Number) (Nummer)	(Country) (Land)	(Day Month Year Filed) (Tag Monat Jahr eingereicht)	Yes Ja	No Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/00635	01.03.2000	anhängig	pending
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D, M, Y) (Anmeldedatum T, M, J)	(Status) (patentiert, anhängig, aufgegeben)	(Status) (patented, pending, abandoned)
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D,M,Y) (Anmeldedatum T, M; J)	(Status) (patentiert, anhängig, aufgeben)	(Status) (patented, pending, abandoned)

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Voller Name des einzigen oder ursprünglichen Erfinders:	Full name of sole or first inventor:
BERNHARD RAAF	BERNHARD RAAF
Unterschrift des Erfinders Datum 03.09.2004	Inventor's signature Date
Wohnsitz	Residence
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81475 MUENCHEN DEX	81475 MUENCHEN
Voller Name des zweiten Miterfinders (falls zutreffend):	Full name of second joint inventor, if any:
Unterschrift des Erfinders Datum	Second Inventor's signature Date
Wohnsitz	Residence
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